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RESEARCH WORK NEEDED IN FOREST ENTOMOLOGY

By
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And

ACCOMPLISHMENTS IN RESEARCH

By
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RESEARCH WORK NEEDED IN FOREST ENTOMOLOGY

By Elers Koch

I can approach this subject only from the position of a layman. I am not an entomologist, but I have certain responsibilities in directing and planning the job of protecting the National Forests against insect attack.

In pursuance of this job there are many questions which arise, the answer to which would have important influence on the line of action taken. In the absence of such an answer we often have to proceed on the basis of an hypothesis which may or may not be correct, and if incorrect may result in entirely wrong action, often involving the useless expenditure of many thousand dollars or the loss of many million feet of timber.

The first group of questions pertains to the life history and habits of forest insects, particularly bark beetles.

What laws govern the spread of an infestation? In the case of a vast and destructive epidemic such as now exists in the lodgepole region, what causes it to start in the first place? Why do some epidemics reach a sharp crest and rapidly decline, while others seem to go on indefinitely? Does a great epidemic spread like a forest fire from a definite center, sending out advance small

centers like spot fires, which then consolidate and are incorporated in the general advance of the main wave, or does the same mysterious condition which started a normal endemic aggregation of beetles to breeding furiously also operate at distant unconnected localities, so that there is no physical connection between one center and another? Can the whole lodgepole epidemic, which since 1911 has spread over the Flathead, Blackfeet, Kootenai, Lolo, Bitterroot, Beaverhead, and Deerlodge Forests in Montana, over all the Central Idaho lodgepole region, and now threatens to swallow up the whole Yellowstone Park group of forests, and perhaps make its way clear down through Wyoming into Colorado; can this epidemic all be traced to one little group of insects that felt a primeval urge to increase and people the earth? It sounds incredible, but the fact remains that the successive waves of infestation can all be traced to expansion in one direction or the other of the older major bodies of infestation.

Is there any limit to this relation? When new beetle centers begin to appear in the Targhee or the Yellowstone Park 80 to 100 miles from the main Beaverhead and Idaho centers, are they independent buildings up of the local beetles, or did they all come in by long distance flight from the crowded multitudes in the Beaverhead? Is it

possible that the successive waves of the infestation are not physical movements of the beetles themselves, but a successive progress of whatever mysterious condition it is that might permit the local beetles to take on an epidemic rate of increase?

I do not even pretend to know how to approach an answer to these questions, but answered they must be before we can appropriate money for control work with any assurance that it is not hopeless.

Another phase of life history and habits that is shrouded in mystery is the selectivity of species. Mountain pine beetles will attack freely and destructively all of our major pine species, lodgepole, white pine, ponderosa pine, white bark pine or limber pine. If my observations are correct I can show you areas on which the beetles apparently swept through, taking out all the lodgepole and leaving the white pine almost untouched, and where a later infestation pretty well cleaned up the white pines. In the Kootenai the beetles are ravaging the lodgepole, are hitting the white pine to a much less degree, and are hardly touching the ponderosa pine at all. At the same time, in the Bitterroot the same beetle is moving down the valley with terrific mortality to the ponderosa pine. What is the relation to species? Will a lodgepole bred mountain pine beetle indifferently attack a lodgepole or a white pine, or are

there parallel epidemics of two strains of beetle? At the present time in Pattee Canyon near Missoula D. monticolae is ravaging the small ponderosa pine from 4 to 8 inches diameter, and at the same time D. brevicomis is hitting the big trees. Is there any relation between the two?

Here again we have a series of questions with an immediately practical application. We are trying, apparently with some success, to beat down white pine beetle damage on the Kootenai. Are we throwing away Uncle Sam's money so long as we cannot clean up the vast areas of the lodgepole attack? Do we dare even go into Pete Creek, right up against the edge of the lodgepole epidemic and try to save the white pine? If the Washington Office would release the necessary funds, I would be rash enough to attempt it, but who knows?

No control job is one hundred per cent. complete. Suppose we undertake control work on a dozen different drainages on the Coeur d'Alene Forest. We clean up the bug trees to the best of our ability. A check up the next fall shows that on drainage A we have reduced the bug trees to one to thirty acres, on unit B to one tree to ten acres, and unit C to one in three acres. How can we tell where to stop? If we do no further work in unit A will the few remaining bug trees increase to three times the number next

year, and three times that the following year, so that we have the job to do all over again, or is there a point at which balance is restored and no increase will follow? There is no complete consistency. One unit may have one bug tree to ten acres, and,with no control work, show no increase or even a decrease next year. Another unit, with control work, may show an actual increase next year. Do these insects all come from missed trees, or do they come in flights from another drainage?

Many of these questions can be answered only by repeated trial. The control work which has been conducted for several years in the Coeur d'Alene and Kootenai white pine may be considered primarily as an experiment. We try this thing and that thing, and by careful analysis of results may eventually arrive at a working scheme which will indicate what is possible and what is not possible in the way of control. The great difficulty lies in the impossibility of isolating all the factors. A certain control job is successful. The infestation is greatly reduced. Yet how do we know that natural causes might not have done the same thing? Presumably back of our empirical experiments we need to know the fundamental life processes and habits of the bark beetle before we can predict the probable natural development, and effect of artificial control in any infestation.

The method of approach to the answer to all the above questions I must leave to the ingenious entomologists to develop. A few of the fields that seem to be involved are:

Study of natural ~~periods~~ Parasites and relation to epidemics.

Study of the vast number of questions relating to the life cycle of the beetles, such as reproduction, choice of host material, flight habits, etc.

A long continued study of the geographic progress of infestations

Aside from investigations relating to life habits of insects, there is also a large field for study of practical methods of control work. A good deal of advance has been made on the job by practical men in the Bureau of Entomology and the Forest Service. For instance, in lodgepole beetle control we progressed from trying to peel trees standing to falling and peeling, then to decking and burning, and finally to burning standing trees with an oil spray. Much good work has been done in the way of developing equipment.

In the case of white pine control we are now up against a very concrete problem. Our most common practice in control work has been falling and peeling. We are now facing a doubt as to the effectiveness of this method. With the overlapping of generations, many beetles over-winter in adult form. We do not know how many of these adults are

surviving the peeling process and escaping for new attacks. Possibly we are going to have to abandon the peeling method entirely and burn the log decks. There are also many questions to be finally answered as to the best technique in spotting and treating. Many of these questions are semi-administrative, but a study of methods could doubtless reduce costs and increase effectiveness.

A third general field of study is the economics of control work. This is dependent on results from the preceding groups of life habits investigations and control methods investigations. The sort of questions to be answered in this group are: How much are we justified in expending to control any epidemic situation? What would the probable loss be without control measures? What are the assurances that control measures will be successful? What is the relation between the cost of control measures and the probable loss without control? What stages of infestation indicate control measures? Should we perhaps maintain a constant war on bark beetles and never allow an infestation to reach an epidemic stage? What will be the effect on fire control of the vast amount of dead timber created by insect attacks? What ecological changes in the forest will result from an extensive infestation? How much does our total annual insect loss amount to?

I have confined most of my remarks to bark beetle infestations, but there remain many other insect pests of importance. There is an aphis which is killing a large aggregate total of young white pine. There is the spruce bud worm which has ravaged vast areas of white fir, Douglas fir and hemlock all over Idaho. There is the pine butterfly, larch sawfly and other defoliators. There is the cutworm in the nursery, and a weevil in the base of the white pine. There is the whole field of wood-boring insects.

Most of the above mentioned insects, which are in the aggregate doing a lot of damage, we have passed up with a statement that we do not know any practicable means of control. Surely there is a large field for research in all of these species.

You will probably feel that my suggestions for a research program are indefinite. So they are. As I previously stated, I am no entomologist. As a practising forester I meet certain problems in insect damage and control. I have tried to state some of the questions which constantly arise to be faced. I must leave it to the entomologists to work out the lines of attack on these problems.

December 14, 1932.

Accomplishments in Research

J. C. Evenden

We have been silvicultured, burnt by fire, rotted by diseases, and now it falls to Mr. Koch and myself to turn loose countless hordes of insects upon you. I trust that these pests will bite sufficiently hard to keep you awake at this hour in the afternoon.

I have been somewhat at a loss to know just how the first half of these twofold assignments should be handled. I feel that it is perhaps an easier task for some of us to tell the research needs for the future than to list our progress. The progress of research in forest entomology would seem to me to be somewhat in the nature of a history of our work, which of course would not be of great interest nor would time be available. After an attempt to condense such a history into an interesting and proper length narrative, I have forsaken the task and decided to tell you of the most important of our varied problems and what has been done to solve them. It is difficult indeed to write the word "finis" after a problem, for there are always opportunities for improvement. So though for many of our forest problems we have methods of control which have and are giving success, we are constantly striving to improve them. It is understood of course that a method of control must not only be effective in destroying the injurious insects, but it must be sufficiently economical in its application to permit its institution for the protection of forest values. To predetermine the actual cost of forest insect control is no easy task of itself. Such projects are comparable to the construction of forest trails, roads, fire lines, telephone lines, etc. in that though a fair estimate can be

made of the cost there is often a marked variation in the different projects. This variation in the cost of insect control is due in part to such items as weather, transportation, terrain, etc. and in part to the human factors encountered in the control organizations. The first factor can be fairly well measured, but the second, which I often feel is perhaps the most important, is intangible and more difficult to isolate and correct. I seem to have departed somewhat from my assignment relative to the research of forest insects, though I assure you that the technique of applying control measures to our forested areas in order to secure the most effective and economical results is perhaps our most important problem at this time. Our control operations have very forcefully shown us the need for careful and thorough work. The benefits which we reap from control are in direct proportion to what is put into them. All of our research has as its objective the improvement in the effectiveness of our control methods as well as an improvement in their application. So though I have perhaps placed the proverbial cart in an incorrect position I have no apologies to make.

Forest insects can be roughly divided into two classes: those which attack the bole of the tree and are called barkbeetles, and those which feed upon the leaves and needles and are called defoliators. It is true that there are a few economically important insects such as root and seed feeders which are difficult to place in these two classifications. Of these, barkbeetles are unquestionably the more important, though defoliators are responsible for the destruction of tremendous volumes of timber annually.

Without tiring you too greatly, I hope to tell you an oft-repeated story of the most important insects problems of this region and what we know about them. This story you have heard many times and it is no easy task to re-garnish my statements so that you may be tricked into believing that the story which you are hearing is a new one. My statements must necessarily be in an abstract form, as there is no place in this meeting for the details of many years of investigative work.

The mountain pine beetle presents our most important economic problem of this region. As you know, this insect attacks and kills all species of pine in a very effective and efficient manner. Though successful methods of control are available for outbreaks of this insect, they are somewhat crude and laborious, and oftentimes expensive. To improve upon these so called "cave-man operations" practically the entire strength of the Bureau of Entomology in this region has been devoted to a study of the many phases of this problem. We have studied parasites and predators and are now in position to regulate some of our control operations so as to take full advantage of these beneficial factors. We now know that parent adults after attacking and killing one tree emerge and through another attack destroy a second tree. This knowledge explains more fully some of our heretofore abnormal increases in infestations, and places an increased potential importance upon the tree missed during control operations. We note that these insects are capable of long sustained migrations either from purposive flights or by being carried by air currents. The extent or limits of such flights we do not know, though one

must recognize a potential of an exceedingly long distance. We know that we have had migrations of from 25-35 miles. This information has resulted in drastic changes in our plans for control, bringing more forcibly to us the fact that outbreaks must be controlled before serious epidemic proportions are reached, as it is from such epidemics that long-distance migration occurs. To throw further light upon this question of insect flights, considerable work has been done in this region with traps on airplanes and mountain tops. Though positive information was secured relative to the flight habits of other insects, very little data relative to the migration of the mountain pine beetle was made available by these experiments. We now understand the complicated seasonal history of this insect and can explain why spring peeling methods of control often result in an abundance of early June attacks. We know when spring peeling is effective and when it must be discontinued. Though mature larvae are not destroyed by exposure through the peeling method of control, we know that rodents soon accomplish the necessary destruction. We know that the felling of infested trees to be left over winter, the scoring of the tops of infested logs, girdling of attacked trees, with the many variations of such methods, has but little effect in destroying the insect broods. We know that if poison is injected into infested trees within a certain period following attack that the entire brood will be destroyed. Experiments have been made to determine the length of time following attack that this injection can be successfully made. Though this method of control is successful, we have not as yet perfected a technique of application which is sufficiently economical to permit its

use in actual practice. For infestations of this insect in lodgepole pine an effective and economical method of control has been developed by spraying an inflammable oil upon the bole of the tree, which is then subsequently fired. We feel that under certain conditions and types of infestation this insect shows a decided preference for certain hosts. Experiments have been conducted which substantiate this belief. A more positive knowledge of these selective habits will permit the institution of control against infestations in one species of pine with no consideration of the infestation within other species, or will eliminate the necessity for the control of an infestation within one species if there is no danger of a spread into other more valuable species adjacent. When confronted with severe outbreaks of this insect in lodgepole pine, where the institution of direct methods of control are no longer economically feasible, we are often confronted with the task of preserving groups of trees with high aesthetic value from the attacks of insects. We have experimented with various sprays, injections, etc. in order to establish an immunity to the attacks of these insects. Though some success has accrued from these efforts, we are not as yet in a position to recommend their institution as a positive means of preventing attack.

The Douglas fir beetle offers our next most important barkbeetle problem. This insect attacks and destroys mature Douglas firs. Though considerable time has been spent in the study of this insect, there is still a great deal to be learned relative to its habits, method of control, etc. We know its seasonal history, its habits of dual parent

adult attacks, the parasites and predators, as well as the effectiveness of the different methods of control which are now in use. We know that it finds its most productive field in Douglas fir forests which have been weakened through defoliation. We know that our present methods of control, though laborious and expensive, can successfully be applied to outbreaks of this insect where timber values at stake warrant the expenditure.

The Oregon engraver beetle, Ips oregoni, a so-called secondary insect, often becomes of primary importance in destroying stands of reproduction as well as scenic properties. Such outbreaks are usually the result of unsanitary cuttings, where sufficient slashing is left upon the forest floor to permit the abnormal development of these insects, which for a short time following their emergence from such material attack and destroy standing green trees. The very complicated seasonal history of this insect has hindered the development of control on a trial and error basis. Extensive studies have clarified this problem and now permits the institution of control on a more effective basis.

The attack and ruination of cedar poles by ambrosia beetles, horntails, and wood borers is a problem of no small moment. Sufficient work has been conducted to permit the adoption of rather drastic cedar-making regulations in order to prevent this loss. Further studies should be made to perfect and simplify these methods.

As there are large numbers of insects falling within the rough classification of barkbeetles, there are of course other insects which

are of more or less economic importance. Some of these have received attention, though for the most part they have been neglected in favor of their more economically important relatives.

The defoliators of this region have received considerable attention, though a real intensive study of these problems has not been possible. As a result of a study instituted in 1922 at the time of the last outbreak, we now know that the sporadic appearance of the pine butterfly, which from time to time defoliates large areas of yellow pine, is due to the breaking down of certain factors which reduce the numbers of a parasite which normally holds this insect in check. We also know that though these outbreaks are of relatively short duration, due to the prompt revival of the parasite Theronia fulvescens, from 20 to 35 per cent of the trees are destroyed as a direct result of the defoliation.

The spruce budworm, Caecoecia fumiferana, an insect responsible for tremendous timber losses in the northeastern United States and Canada, was first recorded from this region in 1922. Though an intensive study of this insect in the western United States has not been possible, an attempt has been made to develop a method of control with but little success. A large number of sprays have been tested at different periods in the development of this insect, and though some success has been secured a method sufficiently sound to warrant recommendation is yet to be developed.

The Douglas fir tussock moth, an insect first reported in 1927

as a destructive enemy of Douglas fir and associated species, has of a necessity received but scant attention. Sufficient time has been spent ~~spent~~ upon it to fairly well establish its seasonal history and to know that its occurrence is also controlled through the abundance of parasites. We know that though these outbreaks last but two or three years they are sufficiently severe to result in the death of large areas of high grade commercial timber.

Sawflies and needle tyers are also an economic problem of this region, though more pressing demands have prevented but passing attention to them. There are also other problems of wood borers, scale insects, aphids, needle miners, tip moths, root insects, etc. which are all of some economic importance in our forestry practices. Though we are cognizant of these problems and recognize their importance we have been unable to devote a great deal of time to their study.

In this paper I have discussed only those direct methods of control and what has been done to solve them. In addition, there is the relation of forest insects to the silvicultural management of our forests as well as biological control. It is true that though we have not done a great deal of actual work upon these various relationships their importance is recognized and is constantly before us in all future programs of forest entomological research. In some forest types insects often are one of the chief limiting factors in successful management. Insects frequently throw the proverbial monky wrench into our well organized plan aimed at the production of continuous forest crops. In the white pine and lodgepole pine types of this region barkbeetles so affect the

proportion of species in these stands as to convert the resulting forest into one of entirely different composition, often of inferior species, necessitating an entire reorganization of management plans. The fire hazard which insect epidemics create must be fully recognized in plans of forest protection. Insect damage to forest products can not be neglected, for the moment the tree is felled it becomes susceptible to the attacks of wood-boring insects. So though we can hardly report progress on these problems, it would seem somewhat remiss to pass from this paper without letting you know that they are fully recognized by the organization responsible for their solution, and in years to come as the practice of forestry becomes more intensive they must be attacked and successfully solved.

In closing, I should like to comment somewhat briefly upon the economics of forest insect control, which I believe is a subject worthy of as much investigation and research as perhaps that of insects themselves. I am not a "dollar for dollar" forester, nor do I wish to be classed as belonging to that group of "woodman spare that tree at any cost", for though I believe it is the duty of the land-managing bureaus of both state and federal governments to preserve their natural timbered resources for the present and future generations, I do feel that there is a limit to the expenditures we are justified in making. In measuring the value of the forests at stake, there are other factors besides the immediate commercial value to be considered - those intangible values of watershed protection, preservation of wild life, etc., and last but not least the scenic and recreational value which because of our new

system of highways is being enjoyed more and more by the people of our nation. However, it would seem that in all matters of forest protection care must be exercised in the allocation of funds so that there will be at least a fair return upon the moneys expended.

I feel that perhaps I have not covered my assignment as our chairman intended. To report upon the progress of one's research is not an easy task, for oftentimes we find ourselves at a loss to exactly tabulate the progress we have made. Perhaps we shall find and should say that our greatest progress lies in our present understanding of the seriousness and difficulties of our problems. We are no longer satisfied with the superficial aspects of our work and now realize that we must go beneath the surface and question the reason for the success or failure of our experiments if real results are to follow. Problems of forest entomology deal with both plant and animal life. We find these problems, founded upon strong, well established laws of nature, to be intricately complicated and governed by environmental factors - factors difficult to isolate and sometimes impossible to control. We are obliged to analyze our problems more carefully. The science of statistics comes more and more forcibly into our work in order that we can more accurately measure the leads which are suggested to us.